

Cutter (E.)

PARTIAL REPORT

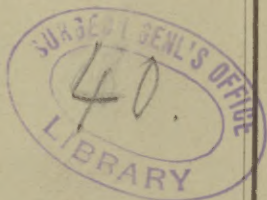
ON THE

PRODUCTION OF VACCINE VIRUS IN THE UNITED
STATES.

BY

EPHRAIM CUTTER, M.D.,
WOBURN, MASSACHUSETTS.

EXTRACTED FROM THE
TRANSACTIONS OF THE AMERICAN MEDICAL ASSOCIATION.



FOR SALE, WHOLESALE & RETAIL, BY
Z. D. GILMAM,
DEALER IN DRUGS AND MEDICINES,
No. 627 Pennsylvania Avenue,
WASHINGTON, D. C.

PARTIAL REPORT

ESTABLISHED 1860.

VACCINE VIRUS, DIRECT FROM THE NATURAL HABITAT,
THE BOVINE ANIMAL,

CAN BE PROCURED BY ADDRESSING THE SUBSCRIBERS.

After long thought, a cell has been at last devised for the conservation and transportation of Vaccine Crusts which possesses the following features:

- (a) Absolutely air and water tight.
- (b) Non-conductor of heat.
- (c) Compactness.
- (d) Transparency — allowing of inspection of the Crust without opening.
- (e) Strength and elegance.

With this cell it is expected that the Crust will bear long transportation and keeping. No extra charge for cell.

PRICES.

One Crust, or one Capillary Tube,	\$3.00.
Ten Ivory Points,	3.00.

PAYMENT IN ADVANCE, CASH, OR P. O. ORDER.

DR. E. CUTTER & BROTHER.

ADDRESS ORDERS TO

WILLIAM R. CUTTER, LEXINGTON, Mass.

EPHRAIM CUTTER, M. D., Woburn, Mass. }
WM. R. CUTTER, Lexington, Mass. }

NOVEMBER, 1872.

PARTIAL REPORT

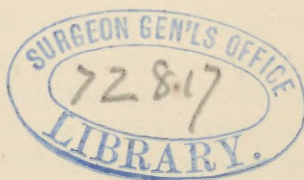
ON THE

PRODUCTION OF VACCINE VIRUS IN THE UNITED STATES.

BY

EPHRAIM CUTTER, M.D.,
WOBURN, MASSACHUSETTS.

EXTRACTED FROM THE
TRANSACTIONS OF THE AMERICAN MEDICAL ASSOCIATION.



PHILADELPHIA:
COLLINS, PRINTER, 705 JAYNE STREET.
1872.

REPORT

REPORT OF THE COMMISSIONER OF THE GENERAL LAND OFFICE
FOR THE YEAR 1881

PROPERTY OF THE GENERAL LAND OFFICE

The following is a list of the property of the General Land Office, as reported by the Commissioner for the year 1881. The property is divided into three classes: land, buildings, and other personal property. The land is divided into two classes: land owned by the United States and land owned by the States. The buildings are divided into two classes: buildings owned by the United States and buildings owned by the States. The other personal property is divided into two classes: personal property owned by the United States and personal property owned by the States. The following is a list of the property of the General Land Office, as reported by the Commissioner for the year 1881.

THE GENERAL LAND OFFICE
WASHINGTON, D. C.
1882

PARTIAL REPORT ON THE PRODUCTION OF VACCINE VIRUS IN THE UNITED STATES.

For several decades after the immortal Jenner had promulgated his discovery we find no efforts to improve the quality of the Vaccine Virus employed in the United States of North America. The only precautions employed were to procure it from healthy human subjects and transmit it from arm to arm.

The effects of such virus were not and have not been questioned by the great mass of the regular medical profession. The physical appearances, the phases and the physiological results tallied so accurately with those laid down by the original authors that most have been satisfied. Perhaps the constant dinging of popular prejudice against the virus ordinarily employed as infecting the system with other diseases besides its own, and the recent alleged cases of syphilis communicated by vaccination, have tended to awaken inquiry into the improvement of the virus.

The alarming prevalence of smallpox and varioloid in cities has also thrown some discredit upon vaccination, and stimulated research into the subject of the deterioration of the virus in ordinary use.

However unjustly aroused the suspicion, the medical profession in a matter of so much moment is obliged to meet it, and exhibit an acquaintance with the grounds of confidence in one kind of virus more than any other. It is the aim of the present paper to allude to some of the efforts that have been made, on this side of the Atlantic, to secure (if possible) a better supply of vaccine virus—premising that it is still to be proved whether this virus is really any better than carefully selected humanized lymph as ordinarily employed.

I. ATTEMPTS TO PROCURE ACTIVE VACCINIA BY INOCULATING KINE WITH VARIOLA.

The first that we notice is that of Dr. John C. Martin, formerly of Attleborough, Massachusetts.

We quote a graphic account from the *Boston Medical and Surgical Journal*.

"Attempt to Procure Vaccine Matter from the Original Source—Production of true Variola. [Communicated for the Boston Medical and Surgical Journal.]

"In the year 1836, Dr. John C. Martin, then a practitioner of medicine in Attleborough, Massachusetts, conceiving that the sometimes imperfect protection afforded by the vaccine disease arose from a deterioration in the matter used, inserted into the udder of a cow, lymph taken from a pock upon the body of a man who died of variola. Subsequently matter derived from the cow was inserted into the arm of about fifty persons. This was at the middle of October. Presently, one Babbitt, being among the first vaccinated, began to exhibit unlooked-for symptoms which alarmed his family. Physicians were summoned, and after examination and comparison of opinions, the patient was declared to have the true smallpox. Then all those who had been vaccinated from the same source inquired anxiously what was to be their fate. The vaccinations (the sequel will show that inoculation was the more proper term) had been made on successive days up to Babbitt's illness, and others soon began to be affected. The physicians in the neighborhood again assembled, and recommended that due precautions should be taken against the spread of smallpox, as probably all who had received the virus from Martin must suffer unmodified variola. Dr. M. became at once the most unpopular of men, although, as I learn from contemporary informants, one of whom was himself a sufferer, the experiment had not been entered upon without consultation, which relieved him from undivided responsibility. Excitement and consternation prevailed, sustained by the consecutive occurrence of new cases. Business was suspended; the panic of fear magnified the danger, and no man could see where it would end. Dr. M. stoutly contended that the phenomena were merely the manifestations of genuine kinpox in its pristine force; but we have the testimony of Dr. Sylvester Fuller, that the disease was variolous. Dr. Fuller was an accomplished physician; had served in the army, where he had seen much smallpox; and his evidence, in concurrence with other physicians of the time, is conclusive. Two hospital houses were established, to which many of those attacked were removed. Four months elapsed before the last patient was discharged. Not all

who received the virus were sick; and of those who suffered, three died.

"The affair quite ruined Dr. M. He went to the West, returned insane, and remained some time in a hospital. He is still living, mildly crazed, but not incapable of intelligently following some simple occupation.

"The senior Dr. Manchester, of Pawtucket, then in active practice, received some of the crusts from Dr. Martin. They are represented to have been thinner, and differing in appearance from the normal vaccine scab, and were not used.

"As the experiment of transmitting smallpox virus through the system of the cow has, at sundry times, been successfully accomplished, the question arises, What was the cause of Dr. M.'s failure and mishap? The conclusion seems unavoidable that the matter taken from the cow was not the modified virus, but identical with lymph inserted from the human subject. Doubtless it had lain in the wound unabsorbed and undigested, and, after a festering process quite local, the eschars were removed, and the non-vaccine matter re-introduced in pseudo-vaccination.

'Take thou some new infection to thine eye,
And the rank poison of the old will die,'

was the philosophy of Shakespeare. Unfortunately Dr. M.'s experiment was in conflict with the injunction. The preservation of the virus unspoiled, while deposited in the cow's udder, is quite consistent with the well-known persistent character of the contagion.

S.

"ATTLEBOROUGH, Feb. 1860."

The next attempt noticed is that of the late Dr. Horatio Adams, of Waltham, Massachusetts. We quote from his address delivered before the Massachusetts Medical Society, May 26, 1858.

"The fact is probably familiar to all, that within the last twenty years it has been shown that the cow-pox can be produced by inoculating the cow with variolous matter. In the October number of the *British and Foreign Medical Review*, for 1839, may be found an account of Mr. Ceeley's experiment of inoculating the cow. Soon after this, in conversation with a gentleman, whom, in the words of another, I am privileged also to call my teacher, my physician, my friend, James Jackson, it was arranged that the writer should repeat Mr. Ceeley's experiment as soon as pure smallpox matter for the purpose could be procured. A brief

account of this experiment, the first, it is believed, that was ever performed in this country with successful results, may not be out of place here.

"On the 11th of January, 1840, I made several punctures with the point of a lancet under the cuticle on the right labium pudendi of two different cows; none of the punctures were sufficiently deep to draw blood. Into each of them was introduced a pointed quill well deluged with variolous matter, and allowed to remain for half an hour.

"On 15th, the punctures were barely visible, but not apparently inflamed.

"On 16th, two of the punctures made on the youngest cow were more distinctly visible; in drawing the finger over them, a slight hardness was felt. None of the other punctures had inflamed.

"17th. These two punctures were more inflamed and a little raised, showing a pearly white flat top, rather small.

"18th. Punctures larger than yesterday, and each capped with a pearly white flat vesicle, with centre depressed.

"19th. The punctures (now vesicles) are enlarged, centres depressed.

"20th. Each of the vesicles is nearly four lines in diameter; surface pearly white, flat, with centres depressed, areola not formed, slight crust in centre. This P.M., end of ninth day of disease, punctured one of the vesicles; found cuticle thick, spongy, and breaking, like what is seen when a vaccine vesicle is early punctured on the arm. Vesicle distinctly cellular. Transparent lymph oozed from the opening, with which I charged twenty quills. Cow appears perfectly well.

"21st. No material change.

"22d. Vesicle larger and more full, areola forming. Dipped several quills to-day; lymph pellucid. Drs. J. D. Fisher, C. Putnam, and Gregerson examined the case to-day.

"23d. Crust forming rapidly, areola somewhat increased in extent, three-fourths of an inch in diameter, round and regular, and somewhat raised above surrounding skin. Cow eats as usual. From this date disease rapidly subsided; a very dark crust was soon formed.

"On 27th, Drs. Fisher and Putnam brought me virus taken from a child vaccinated on the 21st instant, with the matter taken from this cow. The vesicle, as they both affirmed, exhibited the characteristic marks of the true cow-pox on the sixth day of the

disease. Many persons were subsequently vaccinated with matter taken from this cow, and in every instance the true vaccine disease was the result.

"This discovery of the identity, or, rather, I should say, this proof of the identity, of the vaccine and variolous diseases, is the most important fact observed in relation to the cow-pox since the original discovery of Dr. Jenner. For, if any doubt should ever arise as to the genuineness of the virus in use, or if it should at any time be lost, as it frequently may be in certain localities, and smallpox make its appearance, it can be reproduced with certainty by inoculating the cow with smallpox virus."

The writer was present at the reading of Dr. Adams's address, and was inspired to repeat the experiment, as no one had successfully done so since. Accordingly the work was begun in the winter of 1859-60, on a herd of fifty cattle, kindly put at my disposal by that whole-souled merchant-farmer, Mr. John Cummings, of Woburn. The following is extracted from the report made in the *Boston Medical and Surgical Journal* for 1860.

Unsuccessful attempts to produce Variola in the Cow, by inoculating with the Virus of true Variola—Perfect success on using the ordinary Vaccine Virus.—Acting upon the commonly received opinion both of the public and the profession—namely, that cow-pox is smallpox modified and mitigated by a transmission through the system of the cow—it would be natural for any physician to expect to procure pure primary vaccine virus by simply introducing into the system of the cow the virus of variola from the human subject.

It was under this conviction that a series of experiments were conducted upon about fifty kine. It is proposed to give an account of the same in the present paper.

Experiment 1. Nov. 26, 1859.—Inoculated four young kine with variola virus taken on November 19, from one of my own patients, at about the eighth day of the eruption. Punctures were made with a lancet upon the hairless skin beneath the tail and near the vulva. The virus was introduced upon quills and covered with isinglass plaster, as in the ordinary mode of vaccinating the human subject. At the expiration of a week, no effect like vaccination was produced. In fact, there seemed to be nothing more than a moderate inflammation, just such as would result from a non-specific puncture.

Expt. 2. Dec. 27.—With variolous virus taken on the eighth

day (Dec. 22) of the eruption, by Dr. Luther Parks, Jr., of Boston, Dr. Alonzo Chapin, of Winchester, at my request, inoculated five kine. The writer inoculated seven, including steers and heifers.

Punctures were made with a lancet, near the vulva or anus, and upon the teats. The quills, charged with the virus, were introduced, allowed to remain a few minutes, and then suffered to drop out. The operations were conducted with the greatest care, so that there should be no mistake. About five quills were used upon each animal in this as in all the other experiments. On the 31st of December, a few of the spots presented to the feel a round and flat hardness, about half an inch in diameter. One spot had a central depression. This promised so much that it was very confidently expected that vaccine virus would be obtained. But the hope was illusory, for the spot did not pass through the normal stages of a vaccine pustule. On the contrary, it remained the same for more than a week, and then faded away. It was suggested by Dr. Chapin that the virus might possibly have been taken from a varioloid patient (it sometimes being very difficult to distinguish between them), and that thus the experiments proved nugatory. Subsequent experience, however, has not borne out this supposition.

Expt. 3. Jan. 6, 1860.—Visited a patient of Dr. Toothaker's, of Wilmington, sick with severe variola, and charged quills with matter. The eruption was at the seventh day. Inoculated seven kine with this matter, January 6, 1860. In these cases the cuticle was abraded by scratches, made with a lancet at right angles to each other, until the serum of the blood began to escape. The charged quill-points were then rubbed upon the abrasions for a moment or two. No satisfactory results. To be sure, pustules, or something that looked like pustules, were obtained. They were umbilicated, and some of them hard to the feel, but no lymph could be got.

Expt. 4.—Procured some quills, charged with variolous virus, from Dr. R. L. Hodgdon, of West Cambridge, on January 6, and on January 7 inoculated three young kine with the same. The mode was the same as in Experiment 3. No satisfactory result.

Expt. 5. Jan. 13.—Visited, with Dr. Drew, of Woburn, a small-pox patient under his care, and charged some quills in the usual way. Besides I charged some cotton threads, by rupturing pustules and imbuing in the lymph the threads for the distance of half an inch or more at their middle part. Within an hour of the

procuring of this virus, the quills were inserted into several cattle by the usual punctures with the lancet. The threads were introduced beneath the skin by means of a needle. They were then drawn through to the point charged with the virus, and with this engaged under the cutis, the ends were tied, and the seton thus formed left in. The threads remained in for three days. Inflammatory action ensued. There was swelling, with soreness in the vicinity of the punctures. Upon removing the threads, however, these symptoms subsided. No normal pustule was produced. This essay was deemed almost an "experimentum crucis."

Expt. 6. Jan. 18.—Went to Lexington, and took quills and threads from a smallpox patient of Dr. Carrier, in the same manner as was practised in Experiment 5. These were used in inoculating four cattle on the 20th of January. These essays were without success, although the threads were allowed to remain a week.

Expt. 7. Jan. 25.—Received by express, from Dr. John A. Lamson, of Boston, some variolous virus from one of the crew of the slave yacht *Wanderer*. This matter was selected with care, and the case was a well-developed one. These quills were used upon four or five cattle.

At the expiration of a week, there was one pustule developed out of the sixteen or twenty punctures. Took what seemed to be lymph from this one pustule, and tested it, without success, upon another cow.

It is natural to expect, that after so many careful experiments, conducted without success, the experimenter should begin to doubt. I questioned my ability to inoculate; but of this I was not convinced, as I had successfully vaccinated a considerable number of human subjects during my practice of medicine. Besides, I was told by some, who had tried the same experiments without success, that it could not be done; that cow-pox must be found in a natural condition.

In the summer of 1862, the writer visited England and sought out Mr. Ceeley, of Aylesbury. Found him at his residence, and spent some time delightfully as his guest. I also hunted up with great difficulty Mr. Badcock, of London, who had repeatedly procured supplies of vaccinia from variola by inoculating kine. Both these gentlemen assured me that I was successful in my efforts. "*It was necessary sometimes to take an hour to obtain lymph enough to charge one ivory point.*"

So that I really succeeded in my efforts, and did not know it. Moreover, it shows that too much stress should not be laid on the physical characters or phases of a pustule in determining the true character of the disease.

As to the question of identity of vaccinia with variola, the proof is irrefragable; but it must be admitted, that it is with difficulty and almost exceptionally communicated. The method cannot be relied on in urgent circumstances.

There is less reason to regret this, as there is no doubt that the vaccinia can be renewed and propagated readily, and to an unlimited extent, by retro-vaccination. This method has been infrequently practised in this country, until the practice was introduced and demonstrated to be practicable by the writer.

II. RETRO-VACCINATION.

This practice has been adopted over the country, and the writer has been credited with demonstrating that kine may be vaccinated as readily as the human subject.

The manner in which the writer was led into it, was simply this. Feeling much disappointed at the apparent failure of the attempts at inoculation, I was led to doubt the identity of vaccinia with variola, and, as an experiment—

“Jan. 20, 1860, vaccinated four kine with ordinary vaccine, such as I was using in vaccinating the human subject.

“24. The spots all look as if taking.

“26. On two of the four kine, umbilicated pustules, having in one instance a whitish summit, and in other instances being more swollen, with summits less white.

“27. One of the kine has three spots, half an inch in diameter. Bluish color well marked. Took a large number of quills, and on the same evening sent specimens to the members of the Middlesex East Society, and to other physicians who had assisted in procuring variolous matter for the purpose of experiment.

“28. Dr. Chapin visited the animals. He was assured of the abnormal characteristics of the *quasi* pustules procured by inoculation, and was satisfied with the normal appearance of the pustules produced by the vaccination.

“Expt. 12. Jan. 23, 1860.—Vaccinated two cows with vaccine virus from a child, on the seton plan. Did not take. Failure probably due to the imperfect moistening of the threads.

"*Expt. 13. Jan. 24, 1860.*—Vaccinated, on the seton plan, four kine, with virus received by mail from Dr. J. D. Mansfield, of South Reading. No other results ensued than what would ordinarily be expected to follow the introduction of an uncharged thread.

"*Expt. 14. Jan. 28.*—Dr. Chapin vaccinated two kine with the virus he ordinarily uses upon the human subject. Both took well, and a large number of quills were obtained from them, which were used with general success.

"Since the last experiments I have often successfully vaccinated kine, both with the crust and the quill. The pustules have generally been large, and have matured upon the eighth or ninth day after vaccination. They vary in size somewhat, being generally very large, and not small. In some, a characteristic blue color of the pustule and vicinity is observed. This happens especially when the seat of vaccination is upon the part of the labium where the skin merges into the mucous membrane. No constitutional effects upon the cows have been noticed."

Since the above was written, the writer has vaccinated heifers, calves, cows, oxen, steers, bulls, to the number of nearly one thousand. This is considered an unusual number. They were vaccinated with a view to supply virus of this description, to ascertain whether it deserved the opprobrium which systematic and other writers have thrown upon matter produced by retro-vaccination. Whether they speak from actual knowledge or not is not stated. *A priori*, the idea of retro-vaccination is according to the principles of common sense.

If ordinary vaccine virus by long use and inhumanization has been deteriorated, it is fair to suppose that by repassing it through the system of the original animal it would regain its original virtues, because being brought into contact with its original soil and source. A magnet is strengthened by a re-contact with a loadstone. But, as this paper does not propose a discussion of theories, and is devoted to announcing facts, we proceed to our relation.

During the late war the Government was made acquainted, by means of a Brooklyn physician, with my procedures. Specimens of my virus were forwarded to the Surgeon General's Office, received a thorough testing, and passed through the ordeal with success. I was ordered to furnish all the virus I could procure by this method, and in doing so the larger number of kine, mentioned above, were successfully vaccinated.

By the kindness of the authorities I am allowed to present the report of Surgeon and Brevet Lieut. Col. J. J. Milhau, who was detailed on a commission to examine my virus and the mode of collecting it.

The report explains itself.

WAR DEPARTMENT, SURGEON GENERAL'S OFFICE,
WASHINGTON, D.C., March 25, 1872.

Dr. EPHRAIM CUTTER, *Woburn, Massachusetts.*

Sir: In reply to your communication of the 21st instant, I have to inform you that you are authorized to use the report referred to in your letter in any manner you choose.

Very respectfully, your obedient servant,

C. H. CRANE,
Assistant Surgeon General, U. S. Army.

Endorsed: New York City, April 4, 1865; John J. Milhau, Surgeon and Br't Lt Col. U. S. A.; Report on Vaccine Virus, from Kine furnished by E. Cutter, M.D., of Woburn, Mass.; Respectfully forwarded to the Surgeon General; Sg'd, R. S. Satterlee, Brig. Gen'l U. S. A., Med. Purveyor. Med. Purv's Office, N. York, Apr. 6, '65.

(Copy.)

NEW YORK CITY, April 4, 1865.

Brig. Gen'l R. S. SATTERLEE, *Medical Purveyor, U. S. Army.*

General: In compliance with the instructions contained in your communication of which the following is a copy, I have the honor to report the result of my investigation.

(Copy.)

MEDICAL PURVEYOR'S OFFICE,
NEW YORK, March 27, 1865.

Lt Col. J. J. MILHAU, *Surgeon U. S. Army.*

Sir: That I may be well assured of the quality of the Vaccine Virus from the Kine, received from E. Cutter, M.D., of Woburn, Massachusetts, you will proceed thither and carefully investigate the subject; keeping in view the purity of matter, healthfulness of animals, the manner of procuring the crust and other subject relative to the *Virus* that it is interesting to the Medical Department to know.

Respectfully, your ob'd't servant,

(Signed) R. S. SATTERLEE,
Brig. Gen'l and Med. Purveyor, U. S. Army.

In accordance with the above, I left New York on the 29th ultimo, reached Woburn, Massachusetts, the following day, and called upon Ephraim Cutter, M.D., who expressed his readiness to afford me every facility for investigating the subject. As my visit was entirely unexpected, there was no opportunity to make preparation, that might have given me a wrong impression; I found that Dr. C. had already made arrangements, in the ordinary routine of his business, for vaccinating certain cattle, and also for collecting the virus from others, I therefore accompanied him in his rounds and visited stables in Lexington, Lincoln, North Woburn, Jamaica Plains, and Brookline, and personally inspected the condition of over fifty head of cattle. Twenty-nine, mostly cows, had been vaccinated, and the loosened crusts were collected by Dr. C. in my presence, and I assisted him in vaccinating fifteen other cows. All the cattle vaccinated were of good stock, and of healthy appearance, well fed, and kept in clean, dry, and well-ventilated barns.

The "Natural Spontaneous Kine-pock" occurs but seldom in the cows of that district of country; occasionally the doctor's attention has been called to vesicular eruptions on the teats of cows with their second or third calf; he has vaccinated other cows with the virus taken from these vesicles, but, until recently, he has failed in producing the vaccine disease in this way; he is led to believe that cows are subject to eruptions on the teats which are not always kine-pox, or that the vesicles are broken in milking, and rendered too imperfect to communicate the disease.

The virus which he has been using in vaccinating cattle, and from which he has obtained crusts, was originally taken from the vaccine vesicle on a child, and reproduced in the kine.

Some three weeks ago, Mr. Jewett, a farmer near Lexington, noticed a vesicle on the teat of one of his cows with her third calf. Dr. C., being informed of it, took virus from the vesicle and introduced it into another cow, producing a characteristic vaccine vesicle, and with the lymph from this second cow were vaccinated Mr. Jewett and a heifer. I saw them both, the farmer had two fine vaccine vesicles on the arm, and complained of a little constitutional disturbance; he had been vaccinated in early life; in the heifer the characteristic scab had formed, and was nearly ready to be detached. I think there was no room to doubt but what this was actually the *kine-pock*.

The original cow with the scar on the teat, the second cow with

a fresh cicatrix, and the heifer with the scab, were all in the same stable at the time of my visit.

Early in March, Dr. C. found a case of spontaneous cow-pox in a cow with her second calf, the virus was tested by vaccinating two cows, on the Tuft's farm in Lexington, and obtaining characteristic vesicles and scabs. I inclose herewith a specimen crust of the natural and spontaneous cow-pox.

I examined twelve cows that had been vaccinated with this matter, and the crusts on them had the same appearance as that on the heifer above referred to, and did not differ from those on the cattle vaccinated with the virus reproduced from the child.

As Dr. Cutter now expects to furnish crusts produced by matter from the "natural and spontaneous" cow-pox, I recommended that he should put them up separately and mark them so that they might be known to the Department, and I would respectfully suggest that when received they may be issued to such officers as will give them a fair trial and report the result.

In vaccinating the kine, Dr. Cutter uses the lymph taken on the eighth day, or the crust collected on the twelfth or thirteenth* day, and rubbed down with a little water to the consistency of cream. He objects to glycerine, because a physician in his neighborhood had the misfortune to spread phlegmonous erysipelas among the patients he vaccinated, many dying in consequence, and the general opinion of the profession was that the glycerine, in which the crusts were dissolved, had undergone some chemical change while carried in the vest pocket. In selecting matter for vaccinating the cattle, Dr. C. is necessarily very careful, as he holds himself responsible to farmers for the value of the cattle should they be injured by the operation; this I consider a good guarantee for the purity of the virus used, especially as the farmers are not entirely free from prejudice on the subject.

In vaccinating, fifty to seventy-five insertions of virus are made in the hairless spaces under the tail, about the perinaeum, and in the commissure between the hind legs; all these insertions, however, do not take, more than half fail, owing to imperfect instruments, duplicature of the skin, rubbing of the tail, etc.; a cow with seventy-five punctures will probably not give more than fifteen or twenty perfect crusts, in some cases I saw but four or five good scabs on the animal. About two per cent. of all the kine vaccinated refuse to take the disease, being probably protected by having had the natural pock.

The crusts are fully formed, ready to be collected on the twelfth or thirteenth day, and fall off by the fourteenth; the scabs vary much in size, not only in different animals but in the same individual. In collecting the crusts, only the perfectly formed are taken, those that have been rubbed or scratched show a peculiar lustre and are rejected; hence, to obtain a number of good crusts, vaccination should be performed during the season of the year when the cattle are kept quiet in stables, and are not annoyed by insects.

After being collected, each crust is put up in wax; this is a nice operation, as heat must be used to cause adhesion of the wax, and must be so moderate as not to injure the virus; a tin canister filled with water of the proper temperature answers the purpose.

The lymph, when collected, is taken on the eighth day, by means of a capillary glass tube, which is afterwards hermetically sealed.

In conclusion, I would state that Dr. Cutter devotes much of his time and attention to the subject, and personally attends to all the details, the only assistance he receives is from his wife in putting up the crusts.

Having obtained all the information on the subject that I thought desirable, I returned to New York on the 2d inst.

Respectfully submitted, y'r ob't sv't,

(Signed) JOHN J. MILHAU,

Surg. and Br't. Lt. Col. U. S. A.

The report of Surgeon Milhau covers most of the ground. After an additional experience of seven years, I am able to add the following details:—

Kind of Kine Employed.—Any can be used. Sex, age, or condition offer no barrier of themselves, except perhaps pregnancy. In one or two instances I have known abortion to follow vaccination, but it was very doubtful whether the operation acted as a cause. To avoid chance of complication, I recommend to avoid cows well advanced in pregnancy. The previous occurrence of the natural or spurious spontaneous cow-pox is one of the greatest obstacles to successful retro-vaccination. From this there is no protection except in employing newly-born calves.

With bulls, steers, oxen, calves, heifers, cows, farrow and milch, I have had constant success. If I have any preference it is for healthy, well-developed cows, milch, about four years of age; color

black, skin soft and silky. In these the disease has been well developed more uniformly than in any other class.

There seems to be as much difference in the temperaments of bovines as in humans. If an animal of the nervo-sanguine temperament is selected, the operator is exposed to great physical danger, and if successful in the insertion the resulting disease is very apt to be interfered with by the movements of the beast to allay the irritation.



Generally the person who is acquainted with the animal is consulted, and such avoided. A few passes with the fingers over the sacrum and by the flank will determine the temperament of the animal. Generally the process of vaccination is one that both interests and amuses the animal, who will stand still enough. A great deal depends on the method of approach. There should be no loud talking, no boisterous demonstration, nor any violence employed on the animal. Kine are very easily frightened, have long memories, and are apt to resent injuries. They also are much attached to places, and suffer from nostalgia as keenly as human beings. For this reason I prefer to vaccinate them in their wonted stables. When the process is conducted quietly it is more successful. I have never employed constraint. Don't think it necessary to tie them up in frames feet upward.

Methods of Insertion.—I have often been asked, "Where can you vaccinate?" In reply, vaccination can be practised anywhere on the cutaneous surface of the body. I have preferred the hairless parts at the commissure of the thighs. The pustules produced elsewhere are filled with hair. This is objected to seriously by some physicians, but with no good reason, I think. On the other hand, as suggested by my late lamented father, Dr. B. Cutter, the hairs are a most indubitable evidence of the authenticity and source of the virus. A portion of the surface on the flank can be shaved off smooth, and afford a good place for insertion.

Mode of Insertion.—Almost any method which communicates the virus to a broken surface of the cuticle will suffice in a proper subject. The following methods among others have been employed:—

(1.) *Lancet Method.*

(a.) Ivory or quill points charged with virus are inserted into punctures previously made with a lancet, and allowed to remain several minutes.

(b.) Crucial or V-shaped abrasions are made with the lancet point, thus  , and the charged point of ivory or quill is rubbed in; or,

(c.) The lancet is charged, by rubbing a spot of a crust moistened with milk or water till a softened portion is engaged on the end of the lancet, and then the crucial or V-shaped abrasions are made, and the matter applied without removing the instrument from the skin. This is a most excellent method; or,

(d.) The crust may be previously rubbed up with water to the consistency of cream, and then applied by the lancet point to abrasion or puncture previously made; or,

(e.) The lancet point may be dipped in liquid lymph from another pustule or capillary tube.

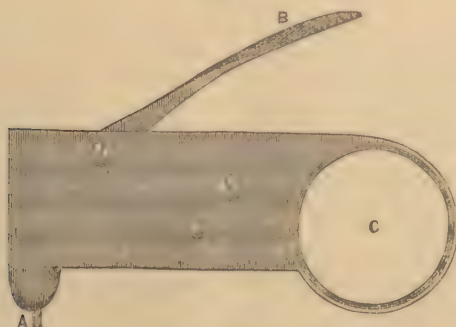
(2.) *Machine Methods.*

These are employed with liquid lymph from capillary tubes, or with comminuted crust.

(a.) Gordon's machine. This was introduced by Dr. Gordon, of Cincinnati. It is a useful instrument. The point of the vaccinator is charged by dipping into the lymph or liquid crust. It is then drawn back and caught by a catch. On depressing the trigger, the spring is released, and the point driven into the cuticle, on which it has been placed, driving in the virus into the puncture. The trouble with it is, that the virus will not always adhere to the point, the character of the point, which is circular, and that the springs often break. It requires two motions to set off the instrument after charging. Dr. Gordon deserves a great deal of credit for this invention.

(b.) Whittemore's vaccinator, Fig. 1, differs from Gordon's in

Fig. 1.



A. Point. B. Handle. C. Finger-hole.

that, with one motion the handle elevates the point and discharges it. This instrument was suggested by myself to my uncle, Mr. Amos Whittimore, of Cambridgeport—a born inventor—and subsequently it was modified to its present form by the Shurtleff of Codman & Shurtleff, of Boston, Massachusetts. The point differs from Gordon's, which is circular, in being a half circle.

The instrument in my possession is supplied with a point of my own device, which gives a V-shaped puncture. Its use is the same as Gordon's. The spring rarely breaks; altogether it is a very reliable instrument.

(3.) The *old-fashioned spring-lancet* is employed sometimes. The incisions made are very superficial, and are afterwards charged by rubbing on the comminuted crust or lymph. Only four knives are employed.

The course of the development of the disease resulting from the introduction of the virus is about the same as that observed on the human subject, with this exception, that the phases occupy less time, and the crust matures earlier.

All pustules in every case are not developed alike. Some will be perfect, large, and umbilicated, and others in their immediate vicinity will be small and imperfect, and yet the seed, so to speak, is the same, the time of sowing the same, the locality the same. Why this is, I know not. We see differences in human offspring of the same parentage, and cannot tell why.

A fact which bears upon the question of the advantages of retro-vaccination is that, by this process, imperfect matter will be brought up by culture, *i.e.* revaccinating into a succession of kine, to a state of perfection. I have repeatedly done this. The skin of the kine is the natural habitat of vaccinia. Vegetation flourishes best on its own native soil; why not vaccinia?

Is the retro-vaccination any better than that in common use?

After the writer had announced the process of retro-vaccination, he tested it in his own practice.

In 1860, "out of nine primary vaccinations with the retro-vaccinia, six took at the first insertion, and three the second insertion. Of fifty-three secondary vaccinations, thirty-nine took at the first insertion, thirteen took at the second insertion, one took at the third insertion. One of the thirty-nine was a lady ninety-one years of age, who had repeatedly been revaccinated unsuccessfully. Another one of the thirty-nine was vaccinated during the prodromic

symptoms of varioloid, and both vaccinia and varioloid ran through their stages side by side. Despite a good scar of the primary vaccination, the pustules produced by the retro-vaccine were large in size and like usual primary vaccine."

The period of incubation of the retro-vaccine is in some cases delayed over the time of the ordinary virus. The period varies, but it has not been observed by the writer to be more than seven days.

Ten or twelve years' subsequent experience has confirmed the above experience in my hands. It gives me great pleasure to be able to produce evidence from others. For the purpose of testing the question further, the writer has furnished considerable quantities of this retro-vaccine to physicians in various parts of this country. Early in January last, a circular was addressed to about five hundred of such, requesting a candid reply in relation to the efficiency of the virus furnished. Of the responses received, about seventy per cent. were favorable; thirty per cent. unfavorable. Most of the unfavorable were mainly inertness—the virus being deteriorated on its passage, in many cases, by the heat of the postal cars or post-office.

It has been a conscientious principle always to send off *ert* virus. Failures will occur in cases where the same virus at home, or returned, will take; so that not always is it the fault of the propagator of vaccine virus, if it fails. It is my impression that the crusts of this virus suffer deterioration sooner than those of human lymph; hence it should be early employed. Heat and moisture are the most destructive agents. Further remarks on this point will be found beyond.

At the risk of appearances, the writer begs leave to introduce some of those who have given evidence as to their experience.

One physician writes:—

"In reply to your communication of 7th instant, received this week, I would say, I esteem 'vaccination from kine' as superior to any. All which I received from you, was in every respect reliable. I vaccinated over three hundred for the Board of Health of this city, in 1863, at which time I largely employed the virus from kine procured from you. The effects were as severe, in my experience, as that of ordinary virus. I have no reason to consider it less, or more, protective. What I liked about the virus always was the clean, satisfactory pustules."

Another says:—

"All the crusts from kine received from you have proved satisfactory, giving very fine perfect pustules, going through regular courses; the scabs from which have served me perfectly through the whole season following, until the hot weather would set in, when I desisted from vaccinating. The ivory or quill points, which I obtained once only, failed, so that I never used them but once."

Another writes:—

"In reply to a circular requesting information in regard to the success of vaccine virus (cow) received from you, I would say, a few years ago I used it entirely in my practice, and was well satisfied with all but the last two or three receipts, which did not take even in primary vaccinations. I remember on one occasion being called to treat smallpox in a family where several of the members had never been vaccinated, and the results were as follows: The first case was ushered in with the usual premonitory symptoms, followed quickly by convulsions. The young lady who nursed the case, I vaccinated with your *cow-pox* virus after the eruption was out upon her patient; *it took*, and so did the smallpox; they ran their course side by side, the disease and vaccine pustule; the latter, I have no doubt, modifying the former, and rendering it a mild case of varioloid. The general results were satisfactory."

"Your circular of inquiries regarding the 'Vaccine Virus from Kine,' which I had received from you, came to hand this day. The virus was always satisfactory in every respect, and always appeared to be as represented. The effects were as severe as ordinary virus; though the impression on my mind is, it was rather more so than virus obtained from ordinary sources. My children were vaccinated from this source—I mean your supply—and though six or eight years have elapsed, they will not now take vaccination by the ordinary virus. I cannot tell how many patients I used your supply on, but I have not seen a case of any form of variola, in private practice, for years."

"My experience in animal vaccination commenced sixteen years ago. I don't know of any other medical brethren in our vicinity who started before us. The occasion of my commencing was finding the *pock* on my cow's teat, and having a friend who would not be vaccinated unless he could have it direct from the kine. All authorities which I consulted, noted the increased

severity of a direct vaccination from kine; but the result proved a mistake, as I repeatedly at that time, and ever since, have used animal vaccine when I could obtain it; and only occasionally have I been without it, and have never seen any severer effects from it, than from the indirect arm-to-arm plan. You have furnished me twice. The last time for my grandchild in San Francisco; which worked kindly, and which was proved to be protective and satisfactory, as my own son was having a severe varioloid attack, and very much broken out at that time; also, when smallpox was very severe in the city, and many physicians even began to distrust the preventive power of vaccination. I therefore have the idea that vaccine direct from the cow, is not inferior as a preventive, and works as satisfactorily and kindly as after repeated use from one arm to another; and, the great benefit of all, the impossibility of introducing eruptive or other disease into the system—though I have never known a case in my own experience where any untoward effect of that kind resulted.”

“I got a crust from you several years since that was the best matter I ever saw. Out of twenty-four persons vaccinated, twenty-two took; some with excellent marks of previous vaccination, and one of them, a lady thirty years of age, who had resisted so many efforts at inoculation before, that she had grown to think that she was not susceptible of the disease. She was a lady in fine health, and the scab from her took well. It is my opinion that the kine-pock virus received from you, from time to time, has acted on the general system with a little more energy than the humanized that I have been able to collect from my own patients, and from my professional brethren, of several removes from the original; and I take great pleasure in saying to you, that, believing yours to be *genuine* kine-pock virus, I have been inspired with more confidence in its use than with promiscuous material, though they were scabs from fine appearing subjects. From the specimens of matter received from you, I think the inflammation in the part, and the symptomatic fever, have been quite as great as with the humanized; but the pock has been decidedly less inclined to get humid and run into a sore. I do not know of a single instance of an attack of varioloid, where your kine-pock virus has been used and has taken well; but know of several where humanized matter had been introduced, within the same space of time, and some of them were pretty well-developed cases of variola.”

“In reply to your inquiries, I will say that the vaccine virus

from kine, which I have had from you at different times on quill points, was perfectly satisfactory to me; always producing smaller, but more perfect sores, and coming to perfection one to two days later from period of vaccination, than those produced by vaccine virus deteriorated by many transmissions through human subjects."

"So far as I am able to judge, it always proved perfectly satisfactory. The local disease always went through the regular stages—papular, vesicular, and pustular—in proper periods of time. The constitutional symptoms were always distinct in their due time. As to the protecting influence, I have not had any opportunity of proving it by any actual case of exposure of the person vaccinated to a case of smallpox, as the disease is rare, and even those who are vaccinated do not expose themselves unnecessarily. I presume, however, that the protection must be complete."

"I remarked no difference in effect between virus from kine and ordinary virus."

"The virus from kine received was satisfactory, except in one particular—it oftener failed to communicate the infection, than that *recently* from human subject. I have no reason to think virus from kine is less protective than that from the human subject, nor have I observed that its local effect was necessarily, or usually, more severe. The constitutional symptoms were usually, though not uniformly, more marked, and perhaps more persistent."

"It never failed to take in any instance of first vaccination, and I have succeeded with it in some instances where other virus had failed. During the winter of 1866-67, smallpox prevailed in M——, where I was practising. I had charge of all the cases. I used your virus in families, one member of which had smallpox, and it failed in no instance to protect those vaccinated with it, though previously not vaccinated. In fact, it in no case failed to be protective."

"Your circular received this morning in regard to vaccine virus. It has given satisfaction in most cases. Its effects have been more severe, and, as far as my experience goes, does not fail any oftener."

"In answer, I will say, that it has been used with satisfactory results, except it has not been quite as sure to take as fresh virus from the human subject. I have used it in the form of a scab. The constitutional disturbance may have been quite as great as from *perfectly healthy* virus from the human subject; yet that disturbance has in no case been one-fourth as great as that I have seen produced by human virus said to be pure. Not one of my

patients, vaccinated with matter from the kine, has been sick enough to require medical attendance, and I consider the protection much more certain than that obtained by human virus."

"The virus I have received from you, heretofore, has proved satisfactory. It seems more active, and less failures in its 'taking.'"

"In reply, I would say, that some of the vaccine virus from kine proved satisfactory, and, so far as I am informed, its effects have been about the same as those of ordinary virus."

"I have had vaccine matter of you several times. It has proved perfectly satisfactory, except one crust from kine, which I was not able to make work."

"The vaccine virus that I have received from you has been usually very satisfactory. I believe only in one instance did it fail. Then I notified you, and I received from you some that proved very efficient."

A number of favorable replies present answers to the question, "*Were the effects as severe and protective as that of the ordinary virus?*" as follows. "Yes."—"More severe; and, as far as I know, equally protective."—"The effects have not been as severe in my hands as that of ordinary virus, or virus from children."—"Not so severe, but equally as protective."—"More so, in my opinion."—"I think as much so."—"I have never seen any particular difference."—Etc., etc.

"It is with pleasure that I reply to a request from you, dated Jan. 7, 1872, asking my estimate of 'vaccine virus from kine,' which I obtained from you about a year ago. The result was satisfactory beyond all expectation. No one took the *disease*, notwithstanding it occurred in an unvaccinated subject, and was a beautiful specimen of the discreet variety, slightly confluent upon the face. I had previously obtained some vaccine virus of a friend in New York, but it was ineffectual. It is my custom to vaccinate by inserting the lymph in at least three places—a point, I believe, too little insisted upon in this country, a single scar not being as protective as two or three or more."

Of the thirty per cent. of replies to the circular, which were unfavorable, the objection was uniformly that the virus was inert—did not take at all. This objection obtains in the humanized virus as well, so that the business of supplying vaccine virus is one of the most troublesome of all departments connected with the medical profession, because of the liabilities to failure.

If the retro-vaccination is as unreliable a process as the system-

atic and other writers represent, it is fair to suppose that evidence of it would have come to light after the lapse of twelve years employment of such virus. I have, myself, witnessed no death from it, though such are reported of humanized lymph.

I think the effects are more severe than those of humanized virus.

In one case, the sites of vaccination suffered a great loss of substance, causing deep conical cavities, penetrating apex downward into the tissues of the arm. Several weeks elapsed before the ulcers healed. The child was of a strumous habit. On the other hand, an almost similar result occurred in the hands of another practitioner *with reputed humanized lymph*, so that one lymph was no worse than the other.

Judging from Husband, who estimates a failure of ten per cent. of primary vaccinations, the retro-vaccine is not so effective in taking as that used from capillary tubes or from arm to arm. Judged, however, by the fact that most of the virus, upon which the basis of this report is made, was used in the form of crust transported to distant places, the balance in favor of it is improved, as the chances of deterioration from heat were increased. If it were possible to hear from all who have employed this virus, a different report might be received. In my opinion, the retro-vaccine is no better than ordinary virus, except that chances of receiving other infections are lessened, and it is probably more protective.

As bearing on the question of the deterioration of the humanized vaccine virus, the following extract from a letter received in reply to the circular, is introduced, showing how thoroughly protective the virus introduced into this country was in its early ages; and is rather an argument in favor of resorting to the original sources for virus:—

“I was born October, 1800, same month first vaccine virus came to the United States, and three years after Jenner’s introducing it to mankind. December, 1800, I and four others were vaccinated. Of these, only myself, and a girl aged six, had the disease. The girl is now living, and the only person I know as having as old a mark as mine by a few years. The virus was used up on us five. The operator had no more for three years. In 1823–24, I attended medical lectures in New York. Variola and varioloid were extensively raging; more fatally, however, in Philadelphia, and even such men as Drs. Wright, Post, and Valentine Mott, professors in

medical college then, had fears vaccine virus had lost its power. One morning, seventy-nine of us pupils together entered the dissecting-room. The first object we saw was a negress's body on the floor, brought in the night previous, for dissection. She had died of variola, the matter standing all over her; many pustules were broken and torn by the resurrectionists' rough hands. Us pupils began to inquire into our safety in this room, where we remained a long time. On examination, seventy-three of seventy-nine had marks of vaccine disease, five variola, and one none of either, of which he was aware, although repeatedly vaccinated. Seventy-eight then vaccinated failed to take, but all had varioloid, more or less. Five pustules or red spots showed themselves on me a few hours, and I, a little sick, was confined one day. The five who had variola, had varioloid as severe as the rest. The seventy-ninth, refusing vaccination, had genuine variola; showing us among ourselves the difference between *variola* and *varioloid*. In 1827, 1836, and 1864, I saw variola next. In 1864, in my practice, *fourteen cases*, and I alone attended all. I vaccinated myself often when exposed thus, and other times, fearing the vaccine disease would fail. In forty-five years of medical practice, I have vaccinated a great many, have tried many twice, thrice, and more times, but never could make good virus cause the vaccine disease but *once* in the same person. Have I not good reason to suppose that *vaccine virus* once fully operating on the system—as it always should—is ~~as~~ good a preventive of variola as *variola* itself? The trouble is, if not half, a great many that are vaccinated, don't have the *vaccine disease*; but say they have been *vaccinated*, and run headlong into danger, get VARIOLA, and then not only they, but the whole neighborhood say, it is no use to pay a doctor for vaccinating, for it is worth nothing. If every child was caused to pass through the *genuine vaccine disease* before one year old, then amen to variola, say I; not but that exceptions may occur; but they will be few and far between."

It remains to suggest that retro-vaccination can be resorted to for the purpose of securing an ample supply of virus in cases where large quantities are demanded, and in a short time. By this process enough could be shortly procured to vaccinate whole communities, if not States. As the virus is so easy to communicate, this process might be resorted to in distant and tropical climates where the supply is limited.

III. NATURAL UNHUMANIZED COW-POX.

"It may safely be asserted that of all the pestilences which have desolated mankind, none has been more fatally destructive than the disease popularly known by the name of smallpox. Other epidemics, indeed, may possibly have surpassed it in destructiveness for a time, while sweeping over the districts of the earth exposed to their ravages. But, their visitation over, they have departed, either never to return, or only after intervals more or less prolonged. The smallpox, on the other hand, in addition to its epidemic visitations, has permanently localized itself in every country it has visited, and, assuming an endemic character, has remained ever ready, when atmospheric or other influences favored its development and progress, to resume the more fatal form of a general epidemic, in the mean time silently carrying off a multitude of victims prematurely to the grave." (*Vide Collinson, Smallpox and Vaccination*, London, 1860, p. 5.)

On the other hand, if it should be shown that vaccine is spontaneously endemic throughout the country, it will manifest the goodness of the Creator in providing an antidote for every bane.

This is a rational supposition. For, if smallpox modified is cow-pox, it would be expected to find it associated together. If one is endemic, the other must be. The secrets of Nature are hard to wrest. She does not yield them to any but patient and persevering observers. The writer is not aware of any systematic efforts being made to settle this question. Still, from the facts that have come to his own knowledge, he is inclined to think that it is so, and that, if earnestly and carefully sought for, the natural spontaneous vaccinia will be found existing among cattle. The writer is the more anxious to press this point, inasmuch as certain of our own physicians have made a great deal of noise in the general public and the profession about their procuring natural non-humanized virus from France, or other foreign countries—asserting that there is not, and never has been, a particle of non-humanized vaccine virus in the United States of North America—except what they have imported. Such advertising sounds empirical, were it true. On the contrary, it is more creditable to a scientific profession to acknowledge the resources of their *own*, while due credit is given to *foreign* countries. Moreover, if it be a truth, and one that is generally understood by the public, that supplies of pure un-humanized, original vaccine can be found among the bovines of

civilized nations—the immortal discovery of Jenner will be doubly enhanced in its value to mankind, because it is so available.

The writer is not prepared to say that such is the case, but begs to present the evidence that he has collected, without a great deal of special effort, hoping that those who are sufficiently interested to read this article will make inquiries in their own localities, and thus settle the case.

In this connection, it may be well to state, that, among the large milk farms of Lexington, Massachusetts, the disease is considered as endemic by the farmers. They are aware of it, and cite cases of vaccination on the hand by milking affected animals, which parallel those famous milkmaids described by Jenner.

Certain barns are more troubled with it than others—for it is a trouble. The pustules occurring on the teats, generally on the hinder teats, and on the apex of the udder, are broken by the act of milking, become very sore, and the animals affected manifest symptoms of pain and distress a good deal more *striking* than the human subjects exhibit in mastitis. The irritation causes a diminution in quantity of milk, and often it has to be thrown away. The cow-pox is, therefore, much dreaded by dairymen. They have the conviction that the disease is communicated by virus that adheres to the milk-stools. The stools are subjected to processes of soaking in water, lime, and other substances, to be cleansed, and yet without avail, for the disease generally goes on till all the uninfected animals have had it.

Heifers with their first calves, and animals from other herds, are usually the subjects of the disease. The heifers because they are milked for the first time, and the others because they are newcomers.

They rarely have it twice. If the farmers' ideas are true, certainly the best method of preserving vaccine virus would be to attach it to milking stools! If the ordinary methods of conservation were as effective, it would be a great boon. The farmers have a strong conviction that the vaccine disease is entirely independent, and has nothing to do with smallpox. They occur without regard to each other.

“Primary vaccine lymph exists in Belgium as well as in other countries.

“To obtain a due supply of cow-pox, the government should accord premiums to the proprietors of cows who promptly make known the existence of true cow-pox.

"Rewards should also be decreed to medical and veterinary practitioners, who by their zeal contribute to its discovery and propagation."¹

Spurious Cow-pox.

There is no doubt but that this is mistaken by the farmers for the genuine. It is contagious, but its phases are different, last longer, and produce a different pustule. Horny-pock are found common. On the other hand, it is equally certain that the genuine cases are not uncommon. The test is applied by vaccinating with the suspected virus another animal, and watching the result. Jenner's method of testing was to vaccinate persons, and then try INOCULATION. It cannot be done now. If the bovine vaccination takes, then we feel justified in trying it on the human subject. One great difficulty in the way is to obtain the virus at the right time. Jenner's discovery of the phases of virus is of very great value here. Something can be judged by the fluidity and limpidity of the lymph as to the right time for insertion of the lymph. A better plan is to wait for the falling of the crust, which is also difficult, as the milking process must go on, or the cow dry up; and it is this severe friction which disturbs, detaches, and probably interferes with the proper development.

The number of pustules varies from one to a hundred. Instances have been known where the pustules have been communicated to the mouth of the calf who suckles, showing an analogy to the variola. The writer has seen many cases of spurious cow-pox, of which he has kept no record. The following may serve as an example:—

Case of Spurious Cow-pox.—Probably (because the lymph may have been taken at the wrong time).

1872, April 2. On the left hind teat of a heifer with her first calf, near the commissure of the teat with the udder inside, was formed a large flattened, non-umbilicated, very white pustule, from which, on the morning of the day mentioned, the milker stated that a large quantity of matter was discharged on his hand. By careful scraping, several ivory points were charged, and two of Husband's capillary tubes.

A fine Dutch heifer was vaccinated with this lymph near the

¹ From Report of Belgium Acad. of Medicine on Vaccination, *Vide Amer. Journ. Med. Sciences*, July, 1858, pp. 221, 222.

crucial commissure, and my brother, Mr. W. R. Cutter, was instructed to watch the animal from day to day.

8th. Report that the matter is taking.

9th. Found nearly all the spots of insertion occupied by prominent, sharp, conical vesicles, except two or three, which were flattened and indistinctly umbilicated. The tips were occupied with very white matter. The animal was kept tied up. There was no well-formed crust on the heifer from which the supposed virus was taken.

16th. The pustules seem to be nearly the same as on the 9th. No sign of any crust; and, what was more singular, there were about a half dozen of clear, horny crusts upon the teats of the animal.

22d. All died away.

Case 2. A portion of crust from the teat of a healthy cow was rubbed up, and vaccinated into two fine healthy cows, with no result. At first the places looked as if taking, but all faded away subsequently. It is very possible that this crust was taken at the wrong time, or was impaired by the friction of milking. Other examples might be cited, but the above must answer. To one who has had the experience of the writer, with retro-vaccination, the failures of this supposed virus were very apparent. They were as unlike the reproduced disease as rupia or pemphigus.

Case 3. While these experiments were in progress, my attention was called to what the proprietors thought were truly genuine cases of the disease. There were two animals, fine creatures, with handsome udders and teats. All four teats were covered with an eruption that closely resembled the desiccated stage of vaccinia. There were, perhaps, fifty hard, horny crusts on each animal. When removed, they were diaphanous and amber colored, and closely resembled a crust from a child's arm. These were tested on three animals, in every case without any success.

Natural Spontaneous Cow-pox Vaccinia.

Case 1. About 1850, Dr. W. J. Currier, of Lexington, Massachusetts, observed on a cow belonging to Mr. Pelatiah Pierce, of Lexington, about one hundred pock, clear, lustrous, umbilicated, and perfect pustules, on a remarkably clean and fair-skinned udder. He took quills, and vaccinated himself and two infants. The children took well, and had a perfect, but severe disease. His own insertion did not take.

Case 2. A similar case has been in Woburn, at the farm of Mr. John Weston, sometime after the above. A milker was vaccinated in his hand.

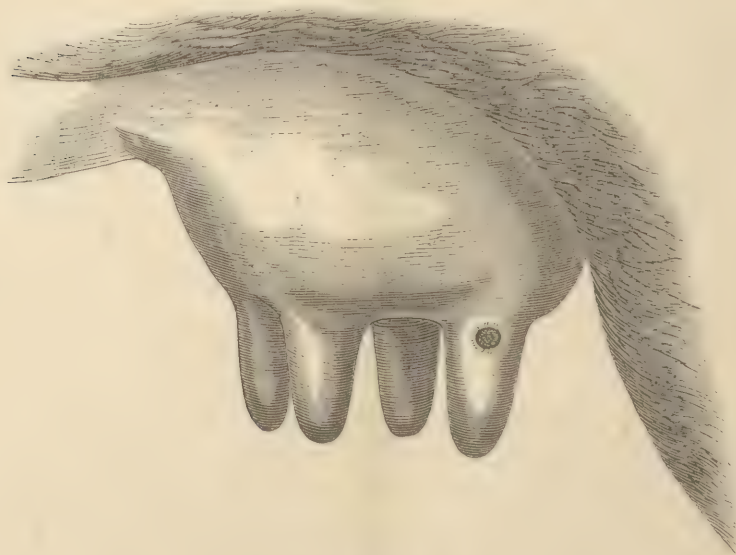
Case 3. My own, detailed above in the report of Surgeon Milhau.

Case 4. That of Dr. John Yale, of Ware, Massachusetts, detailed above (*vide* page 216).

Case 5. Several cases reported by Dr. Hilburn Darlington, of Concordville, Delaware County, Pennsylvania.

Case 6. *Vide* Trans. Medical Soc. of the State of California, 1872, p. 236, Henry Gibbons, Sr., report on Practical Medicine: "*Vaccine Endemic among Cattle.*—In the winter of 1870 '71, an endemic of kine-pock appeared among the cattle on the Point Reyes Ranch, in Marin county. For a long time its nature was not suspected; but, coming to the knowledge of some professional men in San Francisco, it was made a subject of investigation by them, and its true character fully demonstrated. The virus procured from the diseased cows was introduced in the human system, and developed the true vaccinia. To Drs. R. McMillan and J. B. Trask, of San Francisco, is due the credit of the discovery and the experiments."

Fig. 2.



Supposed natural Cow-pox.

Case 7, Supposed.—Cow in my own barn. Disease discovered April 19, 1872. There was but one pustule, situated near the

commissure of the left hind teat with the udder—outside front aspect. It was raised, about one-fourth inch in diameter, circular, umbilicated, black on the central parts from foreign substance adhering. The periphery was whitish, nacreous color. Seen by Drs. Currier, of Lexington, and Drew, of Woburn, it was pronounced a perfect specimen. It was concluded best to allow it to mature undisturbed. It is undergoing this process at present.

Case 8. Occurred in 1867, in the northern part of Wilmington, near the Tewksbury line, on a cow, the property of one Mr. Phelps. This matter was tested and employed by Dr. Jonathan Brown, of Tewksbury State Almshouse, with reported perfect success. Owing to the death of both the parties, the information came through Mr. A. G. Carter, of this town.

Case 9. A gentleman at this Session (Amer. Med. Assoc., Phila., 1872) reports a case of spontaneous cow-pox at Reading, Pennsylvania.

IV. CONSERVATION OF VACCINE VIRUS.

This is one of the most troublesome things to accomplish well. If vaccine virus would keep by the ordinary methods, as well as it does in the instance cited at Lexington, where it is preserved on the milking stools, there would be no occasion for the remark just made.

Heat over 80° Fahr. and moisture are the great destroyers, both combined. On the other hand, cold and dryness are favorable for its preservation.

Freezing.—This process does not impair the virus. On several occasions while vaccinating kine in cold weather, I have had the virus freeze so as to require thawing, and yet prove efficient in the vaccination process.

There is no doubt but that the vaccine direct from kine loses its properties sooner than the humanized. Sometimes it seems as if the heat of the animal's body destroyed it. It is not always so. For on one occasion I vaccinated three cows with virus from another cow which had remained on seventeen days. The crusts were somewhat brittle but diaphanous. They took finely. On the other hand, a humanized crust kept in a bottle for three years and then used, proved ert. So vexatious and curious a matter is this. The writer has spent a great deal of effort, thought, and study, to perfect means of surely preserving, and has failed.

Liquid Lymph.—The best method for long conservation is that of Husband's capillary tubes, made in Edinburgh. These are good for any climate. I don't approve of the French bulged tubes.

Dried Lymph.—Best preserved on ivory points made by the late C. B. Rogers, of Deep River, Connecticut.

The method of enclosing dried lymph between two squares of window glass, sometimes proves very effective. A story was told of a medical officer who took out from England such a supply to India. A square got secreted in a writing desk. After a sojourn of seven years in that tropical climate, the officer returned, taking with him his desk. The virus was then discovered, employed, and found effective.

Crusts may be preserved in (1) wax; (2) gutta serena; (3) tin foil; (4) India-rubber; (5) or my method; two metallic saucers, one-half inch in diameter, one-sixteenth deep, surrounded by a ring of India-rubber; (6) glycerine.

Surest method to have reliable virus is to vaccinate a fresh child or animal, from week to week. This method is employed by Dr. G. L. Simmons, of Sacramento, California, with unvarying success in the case of humanized virus. The disease is in cultivation all the time. It deserves an extensive adoption by all who wish to vaccinate surely and thoroughly.

Glycerine.—"In a recent communication upon the subject (Berlin K. Woch., Sept. 25, 1871), Dr. Muller points out that the purity of the glycerine employed is of great importance, and that those practitioners who have complained that the preservative power is only of a short duration have probably employed an impure article. In his hands, lymph after being kept two years has produced normal pox; and in this way he has been able to store up in the Berlin Vaccine Establishment supplies of reliable lymph sufficient for vaccinating thousands of subjects. Dr. Muller considers that glycerine facilitates the operation of vaccination; dilution of the lymph by its aid producing a far more efficacious and much more intimate and easily employed mixture than when water is employed."

V. METHODS OF VACCINATING.

HOW TO VACCINATE WITH THE CRUST. *Lancet Method.*—Produce crucial abrasions of the cuticle in two spots on the arm with a lancet, by making four vertical parallel scratches, half an inch

long and one-eighth inch apart; cross them with other four like scratches, by scratching the spots in different directions until the cuticle is denuded. Then lay on the spot a portion of the crust which has previously been rubbed up on a vitreous or ivory surface to the consistency of cream; prick it in, and expose the spots to the air till dried; or moisten a portion of the surface of the crust with water; rub it in with the lancet until a portion of the crust is scraped off, and apply this to the abraded cuticle as above. (Martin.) Or, cut from the crust a small triangular section, and insert it under the cuticle, in a little pocket made by the lancet point; cover up with adhesive plaster, and allow it to remain not less than two hours.

Instrumental Method.—Having rubbed up a portion of the crust as directed above, charge the point of the automatic vaccinator, made by Codman & Shurtleff, Boston, and insert the charge into the arm by simply depressing the lever of the instrument. It is necessary to hold the skin tense, and to press the instrument lightly but firmly. Expose the spots to the air till dried. These methods answer for ordinary cases. The following are for difficult ones:—

Blister Method.—After the cuticle has been raised by means of blistering with either empt. cantharides, cantharidal collodion, ammonia, hot water, or heated wire (nail head), puncture the bulb, wipe off the serum, and then lay on a portion of the crust, rubbed up with water. This is very sure. The virus is introduced through the absorbents. The writer has succeeded with it after many physicians had failed.

Croton Oil Method.—Proceed as in the lancet method, and on the next day rub in on each spot one drop of croton oil. This method was first used by a layman. With it he succeeded in making his family take, after his family physician had failed. It is the most sure method that the writer is acquainted with. The croton oil produces an inflammation which excites the lymphatics to activity, and also affords a nucleus for the contagion.

There are other very deserving instruments for introducing virus, but the automatic vaccinator excels in the fact that *one motion only* is required to insert the matter.

HOW TO VACCINATE WITH LYMPH. *Liquid Lymph.*—Husband's tubes. Break off both ends of tube. Place one end in the mouth and blow the lymph out on to the arm, and then prick in with

lancet point, or Whittemore's vaccinator, and expose to air till it is dry.

Or blow the lymph on to the lancet point, make V-shaped abrasions covering each other, and then wipe the lymph on to the abrasions.

Or blow the lymph on to a finger-nail, portion of glass, or crockery surface, then apply by lancet. A tube should not be used at separate intervals without resealing. The process is somewhat thus. Take tube gently between the right thumb and finger like a pen—the charged end being uppermost and the other downwards. Strike the ulnar edge of the right hand with a gentle shock on the radial edge of the left hand. The virus will then joggle down towards the empty end; when it is midway the jogs should be stopped. Seal by putting the end, which is moistened by the lymph, into a flame of lamp or match, until sealed. Then reverse tube—introduce the other end half an inch into the flame. Quickly withdraw till the point is just within the flame, and hold till it is closed.

Probably the surest method is the first named.

Dried Lymph on Quill or Ivory Points.—Make V-shaped abrasions and rub the charged point in.

Or make the abrasions with the Whittemore vaccinator.

It is desirable not to employ any points over a week old, though I have known them to succeed two months old; Dr. Currier a year.

VI. NATURE OF VACCINE VIRUS.

This report would be incomplete unless some allusion was made to the important researches of Salisbury and Hallier. They both have found microscopic vegetations in vaccine virus—human and non-human. Hallier has cultivated both vaccine lymph and variola on lemons, white of egg, starch moistened with solution of phosphate of ammonia. We append the results of the culture with *micrococcus* of smallpox.

“Result of the Cultures with Micrococcus of Smallpox.”—The result of the above cultures, nearly the same as that from the lymph of the vaccine disease, is remarkable, viz., that under the same circumstances, and from the same soil, the same generations or their morphisms appeared; *i. e.* on a dry disinfected plant soil, stand *aspergillus* and *eurotium*; on the fruit-peel of the lemon, *cladosporium-stemphylium*; on dry soil rich in nitrogen *Torula*

rufescens, Fres., with macroconidia from which come *Mucor mucedo*, Fres. But we cannot immediately, on the fruit-rind of the lemon, get pycniden from the micrococcus of kine-pock; it is to be first cultivated on a nitrogenous soil (white of egg), and then transplanted on the lemon.

"While the infection with the vaccine-fungus probably belongs to *Torula rufescens*, Fres., which is to be considered as the younger progeny of *ustilago carbo*, the micrococcus so abundant in milk and even in colostrum, that of the smallpox probably proceeds from the micrococcus which is developed from schizosporangia (sporidesmium-stemphylium), and which always makes its appearance in company with pycniden.

"This result is, therefore, of the greatest practical importance, because the action of vaccination is perhaps thus best transmitted, when kine-pock and smallpox are derived from the same fungus; to guard against the smallpox is nothing else than to infect with the same disease, if the micrococcus is the contagion. The great mystery of vaccination is thus explained—that one who has had the smallpox cannot have it a second time."¹

"*Result of the Cultures with Vaccine Lymph.* The fungi-forms which come from the micrococcus of kine-pock matter, by means of sporoid-forming and sprouting of sporoids, belong altogether to one species, and form the generations:—

1. Of Acrospore: *Aspergillus glaucus*, Lk.
2. Of Thecaspor: *Mucor Mucedo*, Fr.
3. Anaërophytic spores: *Ustilago carbo*, Tul.
4. Fructification: *Erotium herbariorum*.
5. Pycniden, and its subordinate morphisms: *Oidium lactis*; *Torula rufescens*, Fres.; *Ascophora elegans corda*, *Botrytis oidium albicans* (cladosporium), *Jonesii* Berkley.

"Compare with these the next related fungi-forms:—

1. Of Acrospores: *Penicillium crustaceum*, Fr.; *Botrytis elegans corda*.
2. Of Thecaspor: *Mucor racemosus*, Fres.; *Rhizopus nigricans*, Eh.
3. Anaërophytic spores: *Tilletia caries*, Tul.; *Tilletia (lolii Tul.)*.

¹ Vide Hallier, Parasitological Investigations on Vegetable Organisms. Pub. Mass. Med. Soc. (1872), pp. 320, 321.

4. Fructification: *Achlya, prolifera*, Prings; *Pleospora herb.* Tul.

5. *Pycniden*.

"That the morphism shows also a resembling parallelism is evident.

"But the question is, which generation or morphism furnishes the micrococcus of kine-pock? First of all, one affirms, with some assurance, that *mucor mucedo* and *pycniden* have nothing to do with these micrococci, because they do not spring up directly from them, not even on a favorable soil; nevertheless they readily appear sometimes as soon as the micrococcus has vegetated on nitrogenous soil, and after that on dry soil (cork and lemon). *Aspergillus* and *eurotium* hardly furnished kine-pock micrococcus, for they form, in liquid, as I could often show for *aspergillus*, very active micrococcus, and closely, as with *penicillium*, by means of the continued division of spore-nuclei and bursting of the spore-wall; but this micrococcus is quite colorless, not from wine-red to reddish-brown color as that from kine-pock. *Torula rufescens*, Fres., forms a reddish-colored micrococcus. I have for a long time shown this fact, but yet the matter would be better proved by new experiments; and, therefore, *torula rufescens* was first sown on various liquids, and then on boiled human excrement and boiled neat's flesh.

"The forming of micrococcus was energetically going on upon nitrogenous soil. The discharge of the manifoldly divided nucleus is, as was above figured, concerning *aspergillus*. The micrococcus is deep red, especially when seen in mass. From the hard nitrogenous soil the *Torula* sprouted and developed *Macroconidia* and *Mucor mucedo*, Fres., with sporangia, sporangiola, and panicle *botrytis*.

"Further I sowed *ustilago carbo*, Tul., on the same substances.

"The micrococcus I have already described, which have no resemblance with them in color, but are always dark brown.

"On the flesh and faeces the sprouts formed *Torula* chains, afterwards *Macroconidia* and *Mucor mucedo*, Fres. Thus it appears evident that the *Torula rufescens*, Fres., furnishes the micrococcus of kine-pock. Now it is of the greatest interest, that this fungus appears very abundantly in milk, perhaps always in colostrum. I have shown, in the case of swine, that the micrococcus in colostrum for the most part belongs to *Torula rufescens*, Fres. Rarely if ever does primary kine-pock show itself upon oxen, and in cows

it is mostly confined to the udder; hence the conclusion that the cow becomes infected from its own milk, which conclusion is strengthened by the fact, that the disease most frequently occurs upon the cow's calving.

"It is now my duty to state, as I learned by correspondence with Dr. Bender, of Camburg, that this distinguished observer, in 1859, had seen the vegetable organisms in smallpox; that he arranged the first culture, and that his experiment was rewarded with success.

"He wrote me, November 3, 1867, as follows: 'As in the year 1859, compulsive revaccination was ordered, the peculiar form which was observed, brought me to the view, that in and with smallpox matter there must be a vegetative process; and, therefore, I commenced microscopic observations of the lymph, which I had in abundance. Commonly I found, beside the usual morphologic elements, as epithelium-cells, flakes of filamentary stuff, little hairs, etc., fragments of sharply-defined hyaline threads of .009 m. in breadth, and of variable length; twice there were seen larger balls, in great numbers, in the matter of the smallpox pustule, which, on the employment of a solution of potassa, ether, and ammonia, proved to be spores.

"A small drop of vaccine lymph with sweetened water was placed in warm air, which had been filtered through cotton; four days after, a multitude of quickly moving points appeared, whose motion was stopped by acetic acid. Fourteen days after, I succeeded in raising threads which greatly resembled the oidium of aphthæ.'

"Dr. Bender, nine years ago, obtained a morphism of smallpox fungi by culture, and the entire conformity of results from experiments instituted at various times, certainly speaks well for their certainty and correctness. For Dr. Bender, from his cultures, obtained no other thing than *Cladosporium* belonging to *Aspergillus*, *Ustilago*, *Eurotium*, and *Mucor mucedo*, Fres."¹

Salisbury, Vegetation Variola, and Vaccina.—"I have given to the entire plant in all its phases of growth the name *Ios variolosa vacciola*; to the fungoid phase, *I. variolosa*; and to the algoid phase, *I. vaccola*. I have given these names to the two different phases of this vegetation, for reasons which will hereafter appear.

¹ Hallier, Parasitological Investigations, etc. Pub. Mass. Med. Soc. (1872), pp. 314-317.

"In smallpox, this vegetation develops in all its phases. If the vegetation of a smallpox pustule be inoculated into a person who has never had variola, the same contagious disease, in a modified form, and the same vegetation are produced. This vegetation is the *Ios variolosa vacciola*. If, however, the matter of smallpox be inoculated into the cow, a pustular disease is produced, resembling that of variola, but the eruption will only be found to contain the alloid stage of the vegetation, on which account we have given to this stage of its development the name *Ios vacciola*. The fungoid phase of the plant is not produced in the cow.

"If now we take the matter from the pustule of cow-pock, and inoculate it into the human subject, we produce a pustule like that of vaccina and variola, but it contains the stage of the vegetation only that is found in the cow-pock sore.

"Another interesting fact is noticed, namely, that the vaccine pustule does not transmit the disease from one person to another, except by inoculation. The vegetation in this stage seems to have no, or at least but little, power to penetrate the epithelial envelop that invests the body inside and out. The other form of the vegetation, however, which is developed in smallpox, acts as an active contagion, and when the spores fall upon epithelial surfaces that have not had the impress of immunity stamped upon them by a previous invasion, they penetrate to the deeper tissues, and pervade the entire organism, the result of which is the pustular eruption called smallpox.

"These facts are extremely interesting, throwing a flood of light upon some singular features of the disease.

"That the plant in its perfect state does not develop in the cow, while the alloid phase of growth finds in this animal a fertile soil, is highly instructive and significant, and may lead to interesting and valuable results in obtaining matter in other contagious and infectious diseases, that may impart without danger an impress of immunity by inoculation.

"This whole field is one of the greatest possible interest, and is full of rich rewards for the patient and careful student."¹

¹ J. H. Salisbury, M.D., *Microscopic Examinations of Blood: and Vegetations found in Variola, Vaccina, etc.* (New York, 1868.) Pp. 48-50.

CONCLUSIONS.

First.—Vaccine virus has been developed in this country by inoculating kine.

Second.—Vaccine virus has been reproduced by retro-vaccination in this country with success.

Third.—The spurious cow-pock first described by Jenner is frequently observed in this country.

Fourth.—The natural non-humanized cow-pock is endemic in this country, and only needs looking up to be discovered. It is, therefore, unnecessary to levy foreign countries for such virus.

Fifth.—The recent researches of Salisbury in our country, and Hallier in Germany, into the ultimate nature of cow-pock and smallpox shed great light on the subject, and deserve a careful and painstaking series of similar inquiries on the part of unprejudiced and competent observers. The confirmation of these gentlemen's statements would be nearly as great an addition to our knowledge as the original discovery of Jenner.

Sixth.—Except as regards purity from syphilitic taint, the virus from the cow has no special claims above the carefully selected humanized virus in ordinary use. But a resort to the animal vaccination gives an opportunity to procure at all times a supply of vaccine almost unlimited in quantity.

